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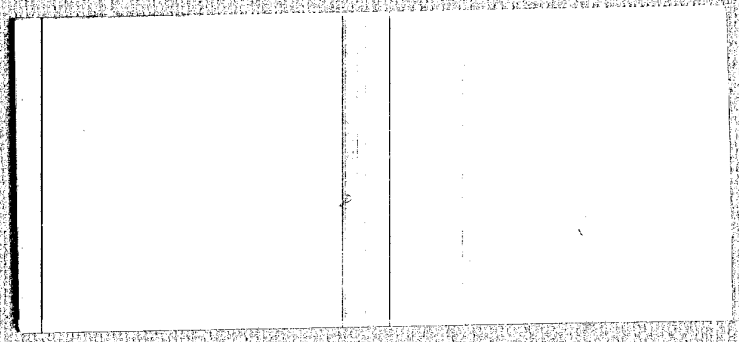
General Mills, Inc.

Mechanical Division



ENGINEERING, RESEARCH & DEVELOPMENT

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This document consists of 20 pages and is number 3 of 16 copies, series A, and the following ** attachments.

12 Photos
2 Drawings
Procurement Flyer

Mechanical Division of
GENERAL MILLS, INC.
Balloon Department
114 Central Ave.
Minneapolis, Minnesota

MANUFACTURING MANUAL FOR THE 20-C-2 AND 25-C-2 BALLOON SYSTEMS

Box II

Prepared for:

Office of Naval Research
Contract NONR 1589(05)

25X1

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Report No. B-1041
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Date: 11 October 1957

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MANUFACTURING MANUAL FOR THE 20-C-2 AND 25-C-2 BALLOON SYSTEMS

I. PROCEDURAL OUTLINE FOR MANUFACTURING 20-C-2 AND 25-C-2 BALLOONS

The following step-by-step procedure is presented as a general outline to aid in setting up a production facility for subject items.

We differentiate between the following functions:

1. Dispensing polyethylene film
2. Trimming off tab on layflat film
3. Heat sealing operations
4. Roll-out of excess air
5. End fitting assembly
6. Packing-sleeve enclosure
7. Sealing packing-sleeve
8. Placing units in package
9. Packaging.

II. BALLOON MATERIAL HANDLING PRECAUTIONS

A. Handling Polyethylene Film

1. General

A small scratch in polyethylene film can cause an early balloon flight failure. The balloon, inflation gas, test equipment, pay load, launching costs, etc., are a total loss if a balloon fails in flight. Savings effected by not expending the time necessary to repair or prevent scratches can result in a loss equal to many times the cost of the balloon itself.

A layer of film as dispensed from the roll may appear to be quite thick. Each layer, however, is only about as thick as a human hair and only slightly thicker than cigarette paper. This thin film is depended upon to carry expensive equipment to high altitudes where temperatures are -50°C or colder. Low temperatures, high altitudes and high velocity winds subject the balloon film to "rough treatment" and unrepaired scratches, cuts, nicks, or scuff marks form weak points which increase chances of flight failure.

2. Cleanliness

It is important to keep tables and equipment free from dirt, scale, grit, oil, grease, foods, and other foreign material. A particle of sand, grit, or scale lodged in the film may produce hundreds of small scratches and may even penetrate the film. Oil, grease, alcohol, cosmetics, and hand creams affect the film adversely and must be kept away from the film.

3. Tables

All persons working at or around tables shall report to their supervisors the presence of slivers, chipped areas, rough spots, etc., which might damage film.

Leaning over tables shall not be permitted except in the normal course of working, as on the sub-assembly tables, and care shall be taken to prevent belt buckles, buttons, zippers, etc., from damaging the film.

No one shall lean on tables with his elbows as this "scuffs" the film. Objects such as purses, boxes, lunch buckets, etc., shall not be permitted on the tables at any time unless authorized by the foreman in charge.

4. Smoking

Smoking shall be permitted only in designated areas. Such areas shall be not closer than 15 meters from any balloon film or manufacturing operation.

5. Fingernails

Personal care of fingernails is extremely important. Persons handling film shall not have sharp, pointed, or ragged fingernails. Smooth, rounded fingernails will preclude the possibility of damaging the film. Fingernails shall not be used to test adhesion of tapes or quality of heat seals. For certain operations, such as lifting tapes to remove air bubbles, foremen may authorize the use of fingernails, for expediency, providing there is no scratching or damage to the film.

6. Jewelry

No jewelry shall be permitted on the hands or arms below the elbows except plain wedding bands with no sharp edges or settings.

B. Marking

Markings on polyethylene film shall be made by china marking pencil or tape only. No other pencil, pen, device, or material shall be used to mark film. When china marking pencils are used, the edge of the "lead" shall be rounded on a piece of scrap polyethylene or paper so that no sharp edge is present. Apply only enough pressure to leave a distinguishable mark. Heavy pressure and sharp edges damage the film and necessitate repairs.

C. Checking Seals and Tapes

No metallic or sharp tools or instruments shall be used to test tape adhesion or quality of heat seals. Pencils shall not be used. Tools for

checking seal, tapes, etc., shall not have sharp points (0.2 minimum radius) and shall be made of wood, plastic, rubber, or similar non-metallic substances.

D. Cutting

Hand cutting shall be done by round-pointed or blunt scissors only. No knives, razor blades, etc., shall be permitted except on cut-off for end fittings.

III. BALLOON FABRICATION

A. Dispensing Polyethylene Film

1. Roll Dispenser

Generally speaking, polyethylene film is sold commercially in rolls. These rolls offer a convenient method for film dispensing if mounted high enough at one end of an assembly or work table to permit the film to be unrolled freely without dragging over the table surface. See Figure 1.

2. Facilities

Before the film is dispensed, facilities and fabricating equipment should be checked for cleanliness and their general suitability for balloon manufacturing. A well-lighted, dust-free area should be used for balloon manufacture.

For details of the balloon work table see Dwg. 231032 included in this report. This table should be marked for end fitting marking lines, and cut-off lines. The table is provided with a shelf approximately 90 mm below the table top to provide a convenient arrangement for sealing polyethylene panels above and near the table top surface, as shown in Figures

2 and 3. Edge "A" in Dwg. 231032 serves as a guide track for the sealing equipment.

The table top width of 1370 $^{+10}_{-00}$ mm (see Dwg. 231032) may be changed conveniently to accommodate sealing of gore panels to the required gore width. The need for this change is dictated either by the limits of adjustment of the heat sealing equipment, or by the moving of the back crease registering line. The latter may be accomplished by drawing a marking line on the table or applying tape parallel to edge "C" (see Dwg. 231032).

3. Material Handling and Inspection

As the film is being unrolled it should be inspected for such defects as holes, striations, cuts, tears, or areas which appear weakened. Defective or weak areas can be repaired by patching with polyethylene tape and so qualify this material as suitable for balloon use. The specifications (see Section IV of this report) on minimum requirements for balloon materials should be followed.

The film should be dispensed and laid on the balloon work table free of wrinkles and in close register ($\pm$ 5 mm) with the back edge or crease edge registering line (see detail "C" of Dwg.231032). In order to maintain good alignment, the film should be weighted with cloth or rubber-covered steel bars (approximately 2 pounds each). Lay up the correct number of panels or layflats to complete the balloon. Add marking and cut-off lines on each panel as the film is laid on the table (for location of marks see Dwgs. 231026 and 231027, Report No. B-1042, Drawings for the 20-C-2 and 25-C-2 Balloon Systems).

B. Trimming off Tab on Layflat Film

1. Layflat

Layflat or tubular material should be cut to the desirable 1/2 gore width as outlined in Dwgs. 231026 and 231027 (GMI Report No. B-1042). A cut is necessary to open up the layflat to provide a sealing edge to be sealed to the sealing edge of the adjacent layflat.

2. Flat Stock

Balloon gores may be fabricated out of flat stock (single sheet) providing requirements for correct circumference are met and other applicable specifications and drawings are followed. The balloon table (Dwg. 231032) should be modified to provide a sealing shelf on both sides. Trimming a tab off may not be necessary if the material is available in a width which makes this operation unnecessary.

3. Operation

Trimming may be done in several convenient ways, i.e., electrical cutter, scissors, etc. It is desirable to avoid a ragged or torn edge.

C. Heat Sealing Operations

1. Equipment

(a) General

Various types of heat sealing equipment have been used to produce acceptable polyethylene film heat seals. The type seal used is not so important as maintaining a consistently good seal meeting the minimum basic requirements of strength, gas transmission resistance, and cold brittleness characteristics as outlined in the material specifications (Section IV).

(b) Band Sealer

A band sealer with 12 mm wide bands gave good operational results at a temperature of 204°C and a band travel of 7.0 m/min (at room temperature of 21.5°C). The sealer was modified so that it could operate on the shelf of our balloon production table. A Variac was added to control the speed of the bands. A seal sample is shown in Appendix A.

2. Heat Seals

(a) All heat seal seams shall be inspected for continuity of seal, strength, and gas-tightness. The inspection should be basically visual. Seals which appear weak or of doubtful quality should be repaired. To determine whether a seal is in need of repair, the following practical checks may be made:

1) Yield test: A test seal should be made before the actual gore seals are made. This test seal should be tensile tested for strength requirements. A convenient check may be made by pulling a portion of the test seal sample with the hands, placing the seal so that handling marks will not appear on the area being tested, and extending the film until it fractures or peels. The seal may be considered satisfactory if the material yields before fracture or peeling occurs at the seal (see Figure 4).

Gore seals can be checked in a similar way. Caution should be exercised, however, so that the material is not stretched to its yield point. Figure 5 shows such a test.

2) Gas-tightness: Folds sealed into a seam should be checked for gas-tightness. See Figure 6. A well-rounded pointer may be inserted between gore panels to check folds for holes or channels in the seal. Figures 7 and 8 show

this operation.

Pressure sensitive polyethylene tape may be used for repair work. It is essential that repaired areas meet the basic requirements as outlined in the material specifications. All pressure sensitive taped areas shall be dusted with corn starch to absorb any adhesive at tape edges. Corn starch acts also as a lubricant, serving to reduce friction.

D. "Roll Out" of Excess Air

Removal of excess air is necessary for the following reasons:

1. Air trapped in a balloon will expand in the same way as balloon gas and will steal from the payload-supporting volume of the balloon.

2. Air inside a balloon will produce a packaging problem. The specified package size makes it necessary to remove excess air from the balloon.

To remove air, foam rubber covered rollers are used. See Figure 9. These rolls weigh approximately 32.5 kg and have an outside diameter of 300 mm.

E. End Fitting Assembly

We differentiate between top and bottom end fittings. For details of the top end-fitting of subject balloon systems, see Dwg. 231024. For details of the bottom end-fitting of subject balloon systems, see Dwgs. 231021 and 231023. Referenced drawings appear in GMI Report B-1042.

The following operations form part of these assemblies:

1. Pleating

It is very important that the gathered polyethylene film of the balloon ends be as evenly distributed around the basic metal part as called for in the assembly drawings. The marking line should be used as a guide line in pleating the material. It should also serve as an alignment marker

in banding the polyethylene material.

See Figures 10 and 11 for samples of fused-pleated ends.

Caution should be exercised during the pleating operation, as well as in distributing the stacked section uniformly around the metal parts, in order not to tear, cut or overstress the polyethylene material.

2. Banding

The basic requirements for a suitable steel band for banding operations are the following:

(a) A corrosion-resistant steel band should be used with an ultimate breaking strength of 680 kg.

(b) Edges of the steel band should be rounded to avoid cutting the balloon film.

(c) The band should be tightened close to the yield point of the banding material. The set screw in the buckles should lock the band securely under this high tension. The buckle should not bend or deform as the set screw is tightened.

(d) The steel banding shall be covered with the proper tape to prevent any metal edges from being exposed.

All end fitting assemblies shall be inspected for gas-tightness and general appearance. The polyethylene material, which serves as a gas barrier, should be free of stress marks, tears, cuts, and holes. Defects should be repaired to meet the basic requirements of polyethylene material as set forth in the material specifications. A disqualified assembly shall be cut off and a new assembly shall be made, providing the total deflated length of the balloon between the end fittings is not shortened by more

than 300 mm. Pressure sensitive taped areas shall be dusted lightly with corn starch. A satisfactory assembly is shown in Figure 12.

F. Packing Sleeve Enclosure

A protective cover should envelop the balloon as outlined in Dwg. 231030 (GMI Report B-1042).

The balloon should be folded in an "S"-type fold and the packing sleeve should be slipped over the folded balloon. The inside surfaces of the packing sleeve should be dusted lightly with corn starch to reduce friction when the sleeve is slid over the balloon.

Care should be exercised to prevent damage to the balloon in the above operation. Before covering the balloon with a packing sleeve, the balloon should be inspected, and all such items as weights, tools, tape rolls, etc., should be removed from the balloon.

G. Sealing Packing Sleeve at Ends of Balloon

Before heat sealing packing sleeve ends as shown in Dwg. 231030 (GMI Report B-1042), the following operations should be performed:

1. End fittings should be wrapped with a soft, spongy, paper-base packaging material. Packaging material should be held in place with some easily removable tape. When applying this tape, polyethylene surfaces should be avoided wherever possible. Pressure sensitive tapes should be dusted lightly with corn starch.

2. Remove excess air from packing sleeve before sealing sleeve. It is desirable to package the balloons in a minimum space. Air removal may be facilitated by using a vacuum cleaner.

3. Heat seal ends as shown in Dwg. 231030 (GMI Report B-1042).

H. Placing Units in Package

It is important that a uniform method of folding and packing the balloon in the box be followed so that the balloon's position in the box can be determined readily.

J. Packaging

The recommended package size shown in Dwg. 231030 (GMI Report B-1042) shows the inside dimensions of the shipping container. Depending on shipping requirements, i.e., by truck, rail, ship (for overseas shipment), a suitable shipping container should be selected which will protect the balloon from damage during shipment and storage. If nailed wooden boxes are used, a reverse nailing method is recommended. In any case, extreme caution should be observed to prevent nails, wood splinters, or sharp edges from protruding inside the box.

IV. BALLOON MATERIALS SPECIFICATIONS

Unless otherwise specified in drawings or sketches, the following criteria should apply.

A. Polyethylene Film

1. Polyethylene film should meet the following minimum requirements:

(a) Tensile strength of 130 kg/cm^2 at a temperature of +21°C.

(b) Cold brittleness - Film should be free of cold brittleness fractures down to a temperature of -56.5°C.

(c) Gas tightness - Gas transmission of the polyethylene film (using H_2) should not exceed 1000 cc per 645.2 cm^2 area in a 24-hour period at 725 mm Hg at room temperature (for 0.038 ±.007 polyethylene film).

2. Fabrication of film should be governed by the minimum film requirements specified above. However, it is realized that in such operations as heat sealing, film repair, etc., the tensile strength may be weakened. The minimum tensile strength of heat seals, repaired areas, etc., should not fall below 98 kg/cm^2.

B. Other Materials Used in the Balloon Construction

1. General Specifications

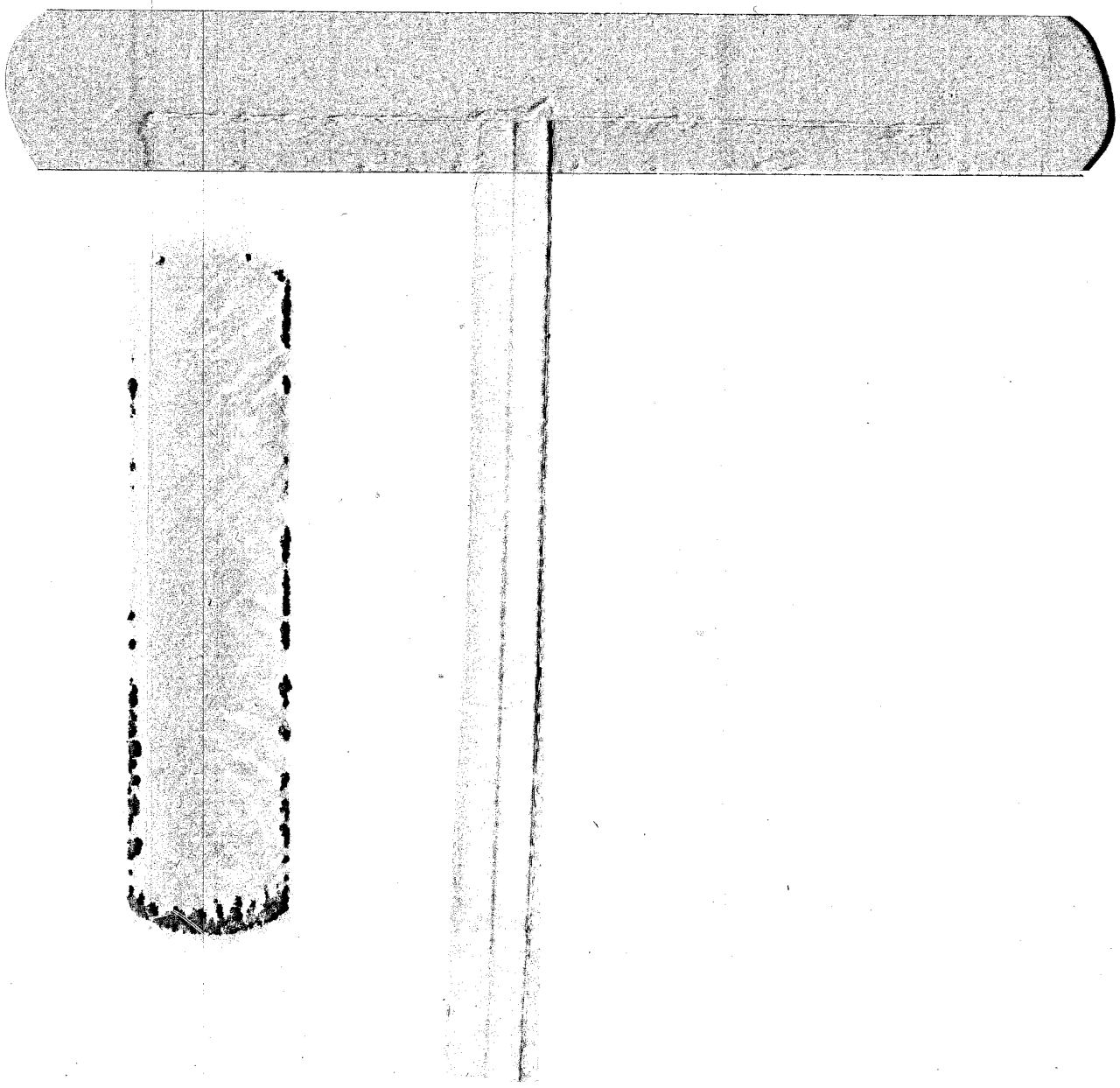
(a) Materials for the other components of the 20-C-2 and the 25-C-2 balloon systems are specified in GMI Report B-1042.

(b) Materials selected should not weaken when exposed to normal handling, high humidity, and/or temperatures up to 60°C for a period of 6 months.

APPENDIX A

APPENDIX A

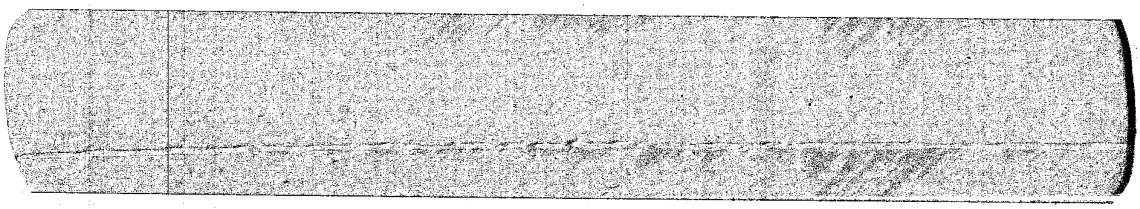
HEAT SEAL SAMPLE

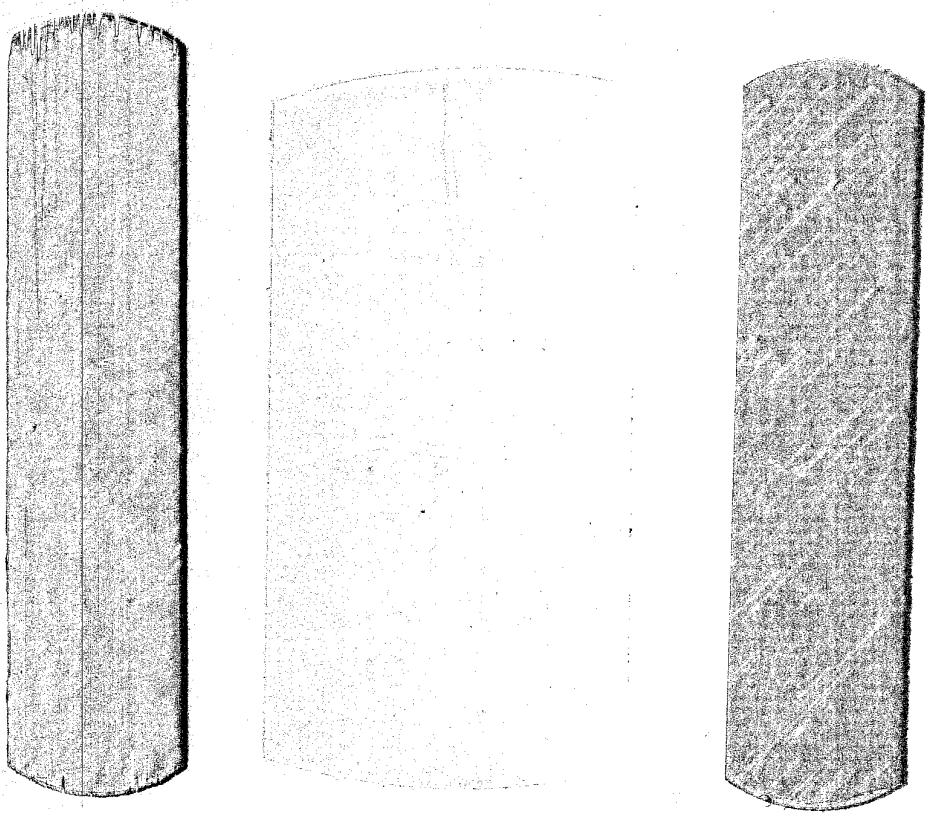


SEALING DETAILS		SEAL TEST	
Temperature of Bands	204°C	Min. Ultimate Tensile	107.45 kg/cm^2
Speed of Bands	7 m/min	Min. Yield Tensile	86.10 kg/cm^2
Width of Bands	12 mm		

APPENDIX A

TAPE SAMPLES





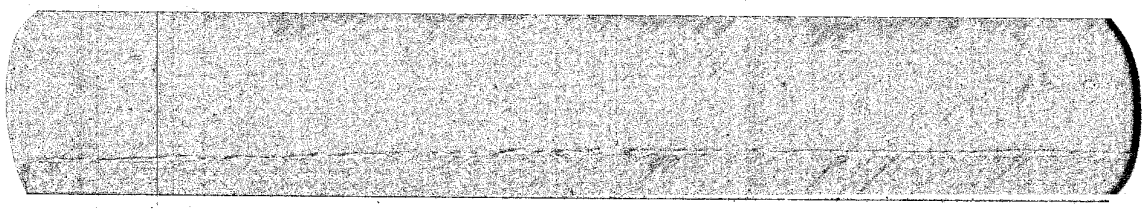
Glass Fibre Filament

Polyethylene

Acetate Fibre

APPENDIX A

POLYETHYLENE SAMPLE



Polyethylene Thickness - .038 ± .007 mm

APPENDIX B

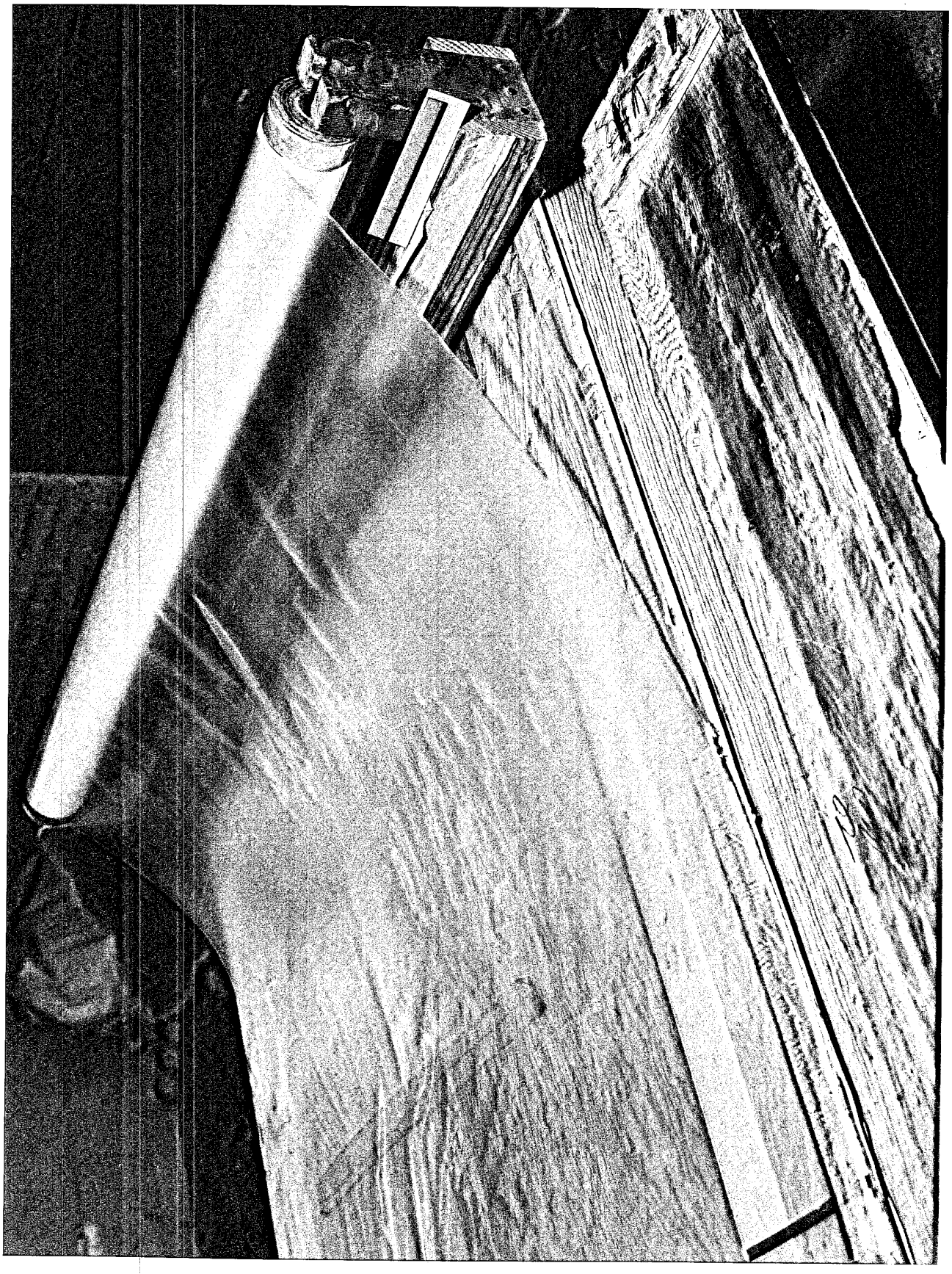


Figure 1. Dispenser

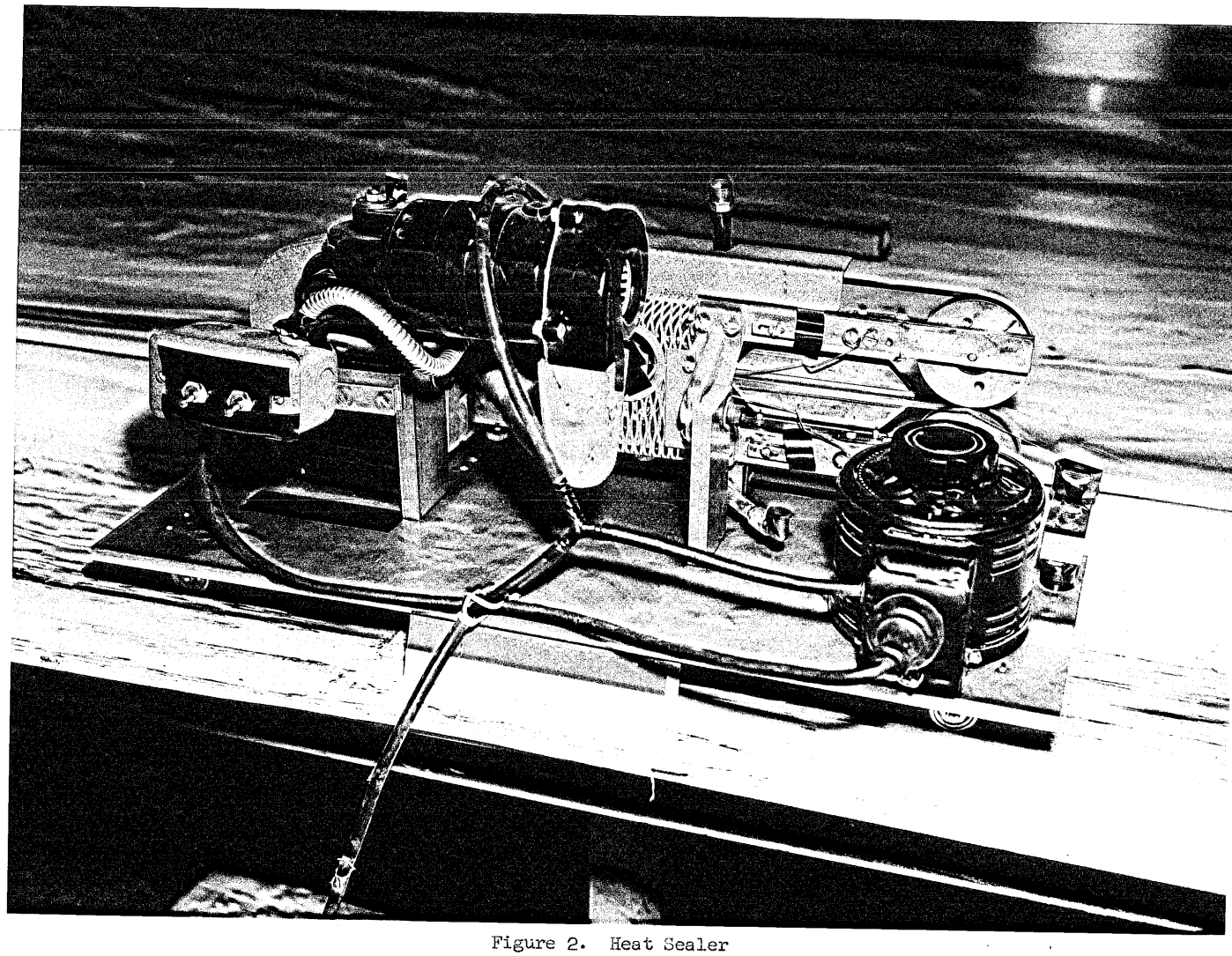


Figure 2. Heat Sealer

(Showing Sealer on Shelf of Balloon Work Table)

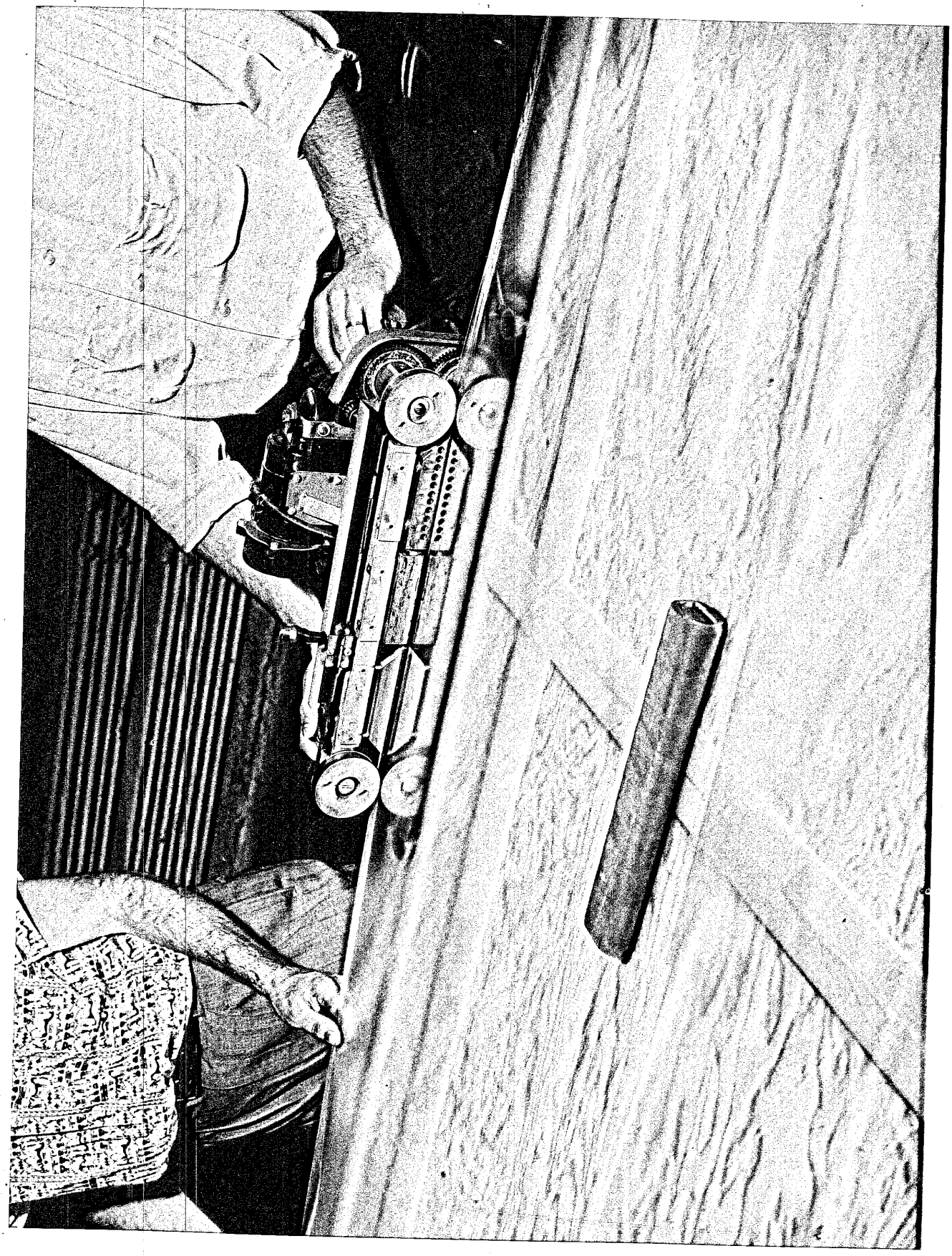


Figure 3. Heat Sealing Polyethylene Film

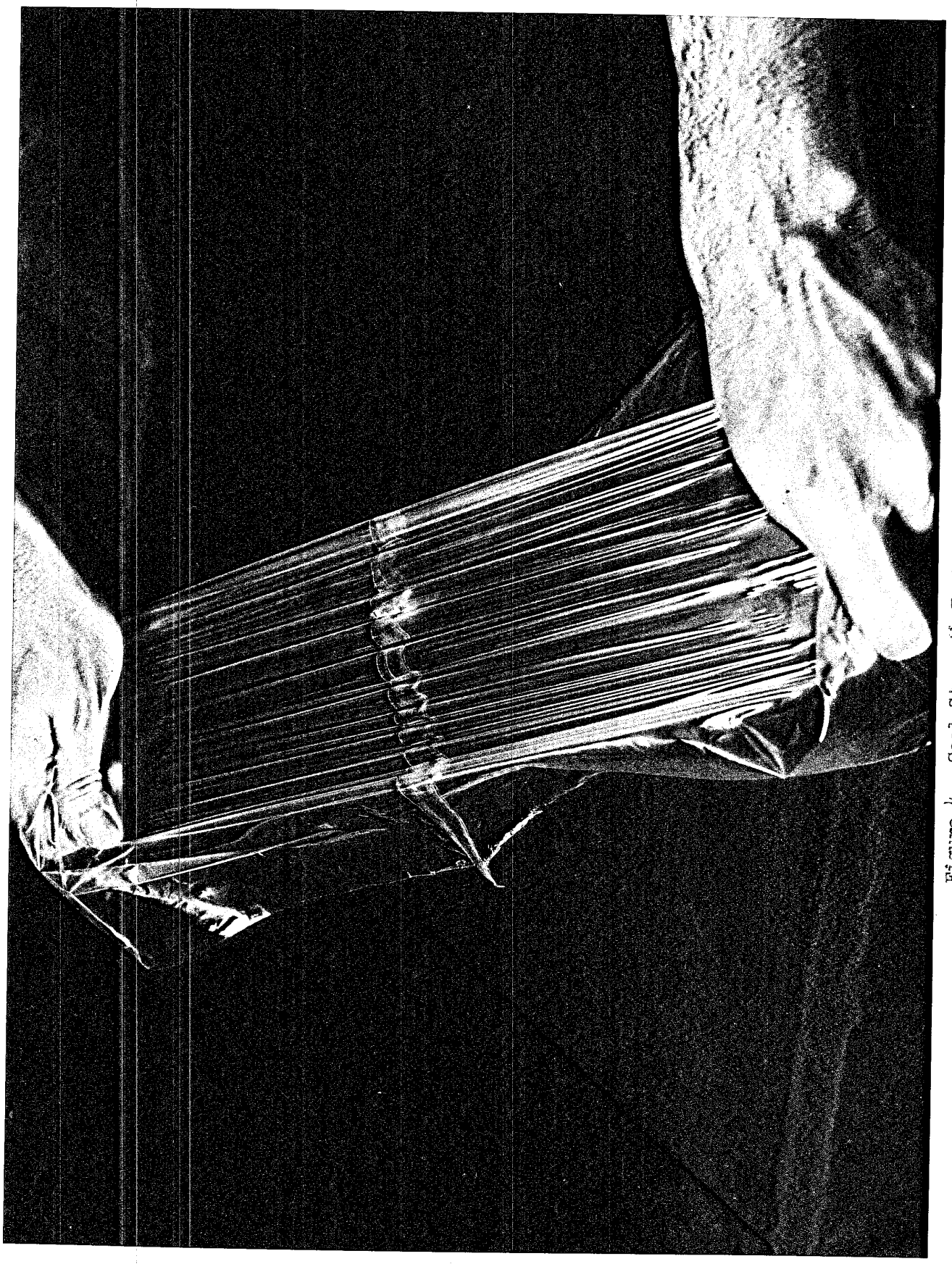


Figure 4. Seal Strength Test of Film Sample

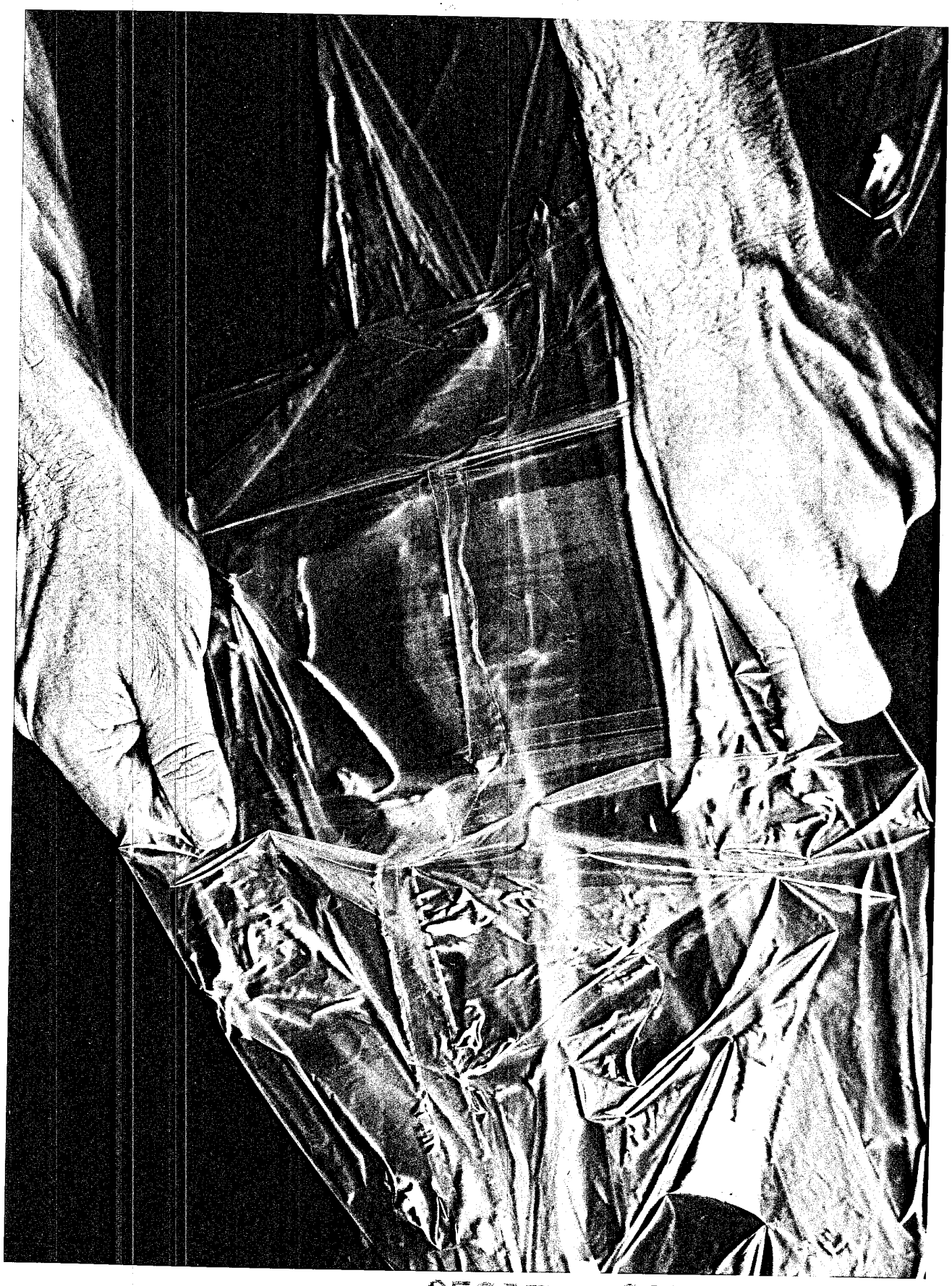


Figure 5. Gore Seal Strength Test

Figure 6. Sealed-in Fold in Gore Seal

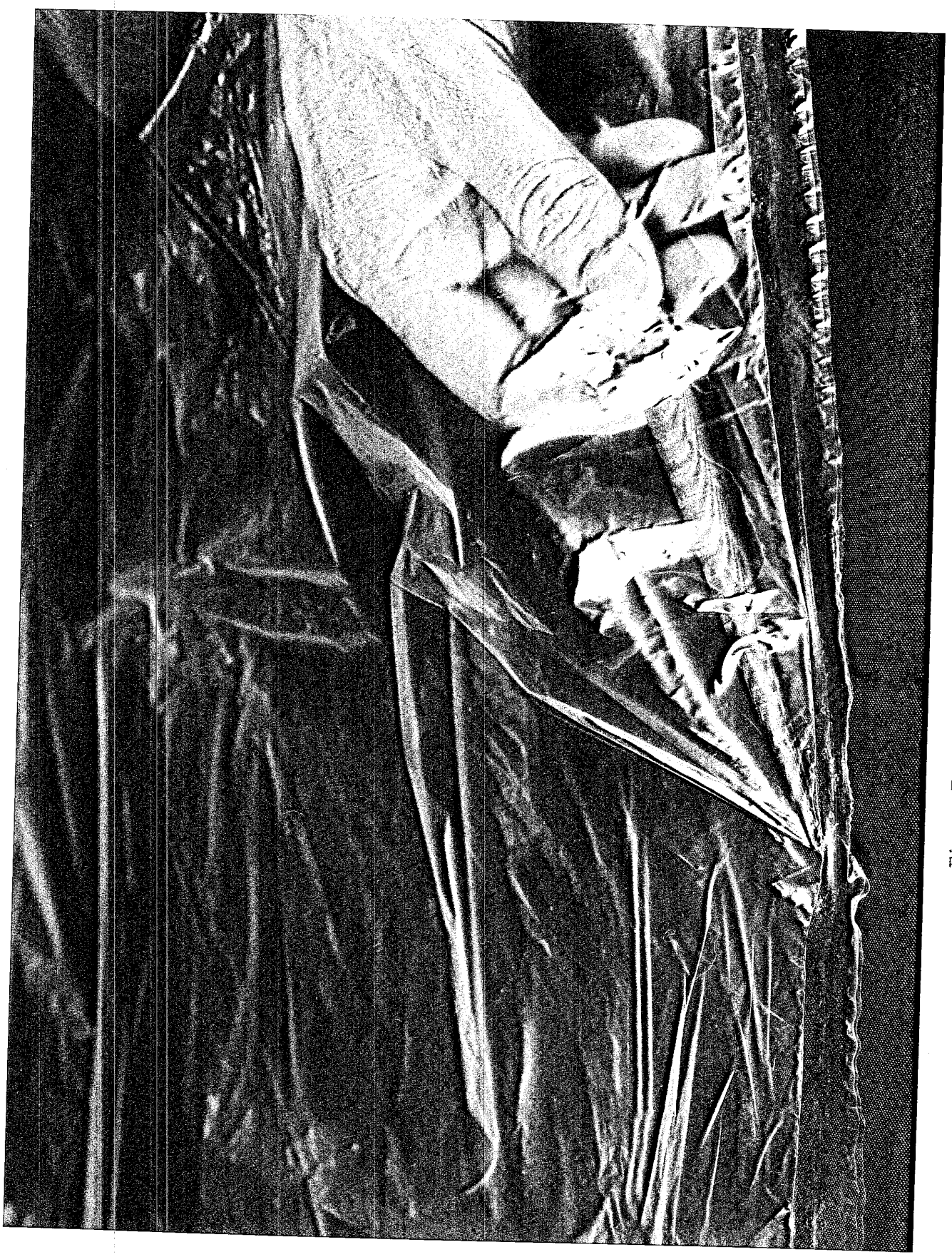


Figure 7. Inspection of Fold in Gore Seal (Between Gore Panels)

Figure 8. Inspection of Fold in Core Seal
(External Check of Fold)

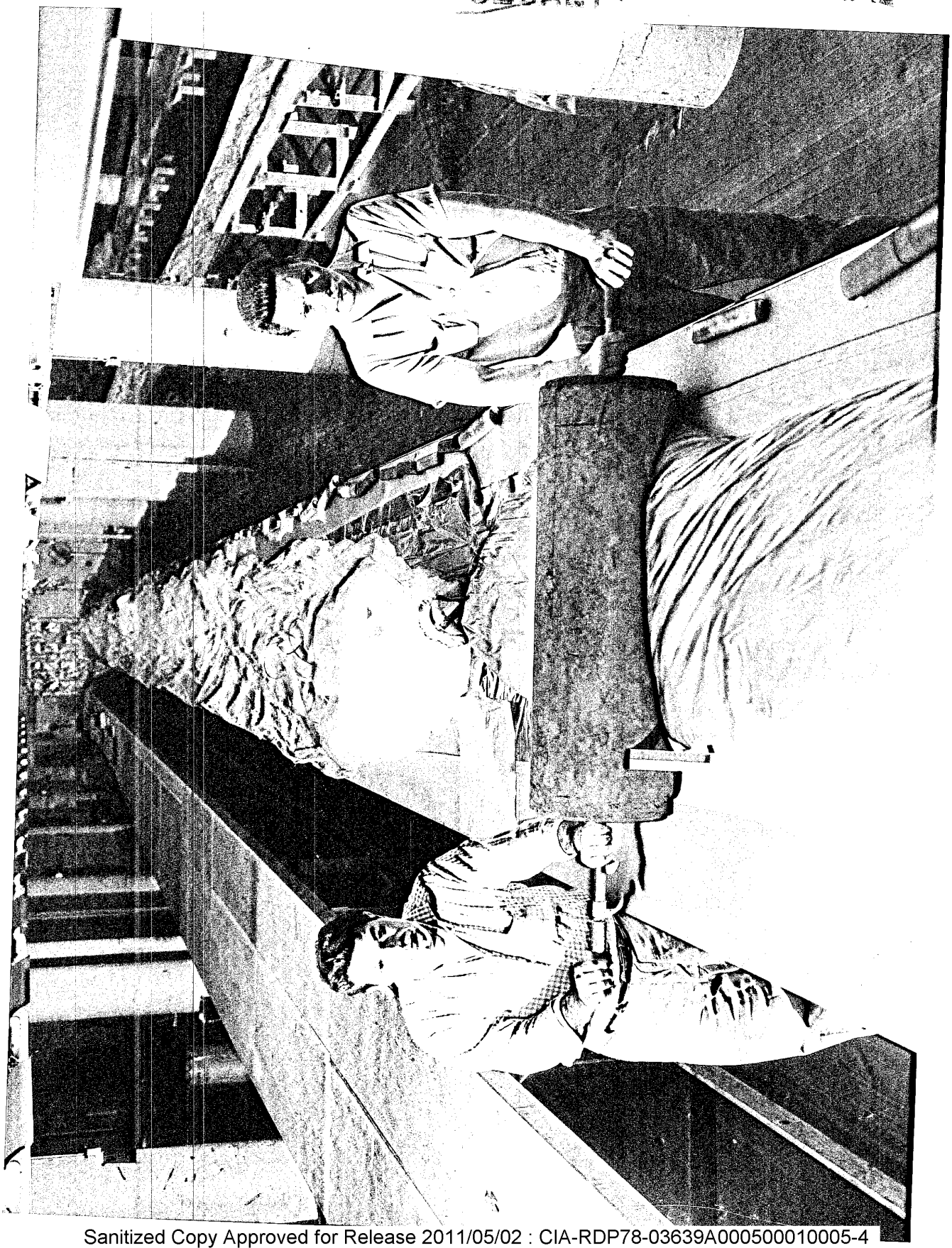


Figure 9. Air Roll-Out Operation

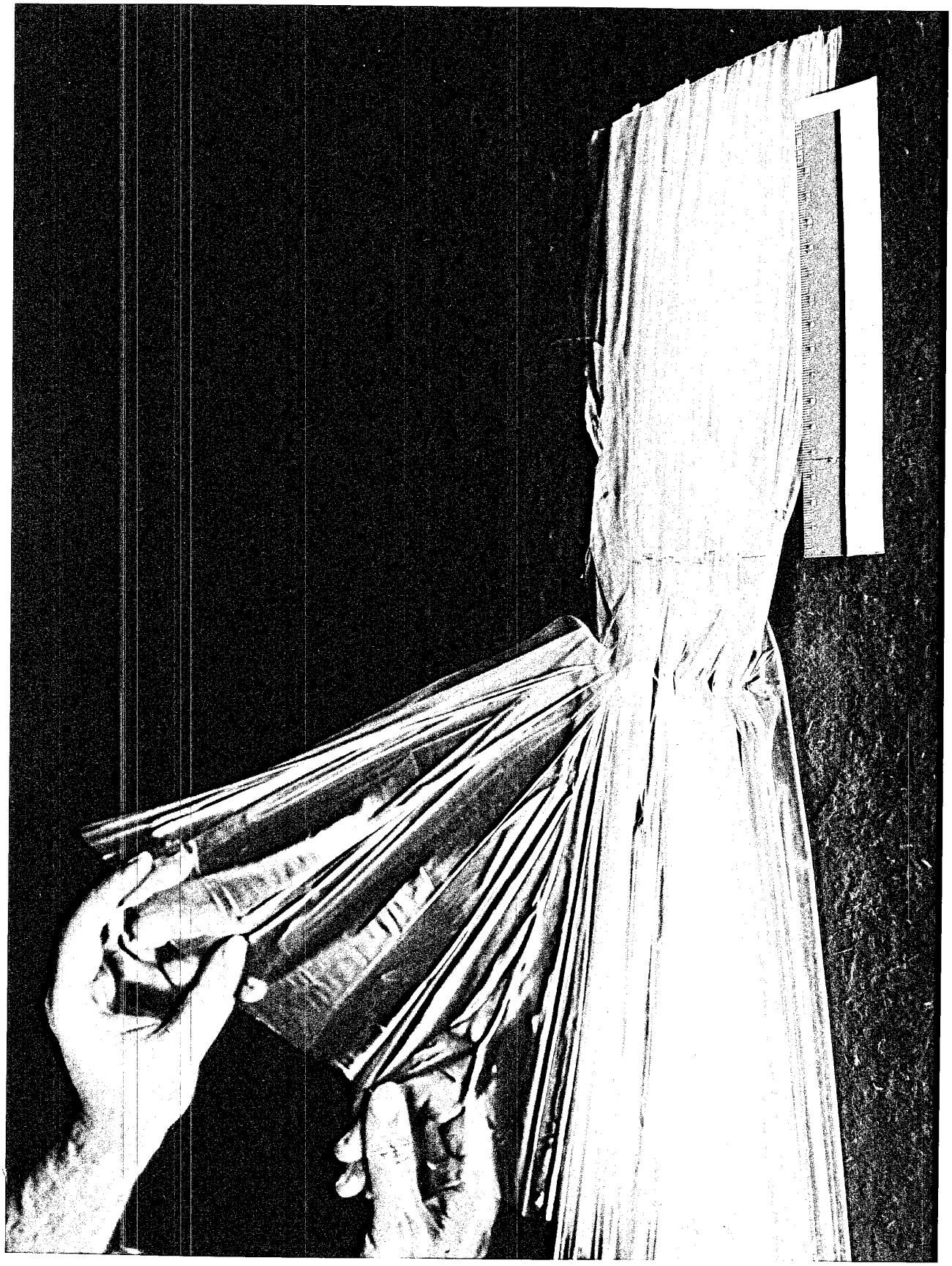


Figure 10. Pleating and Fusing of Balloon Ends

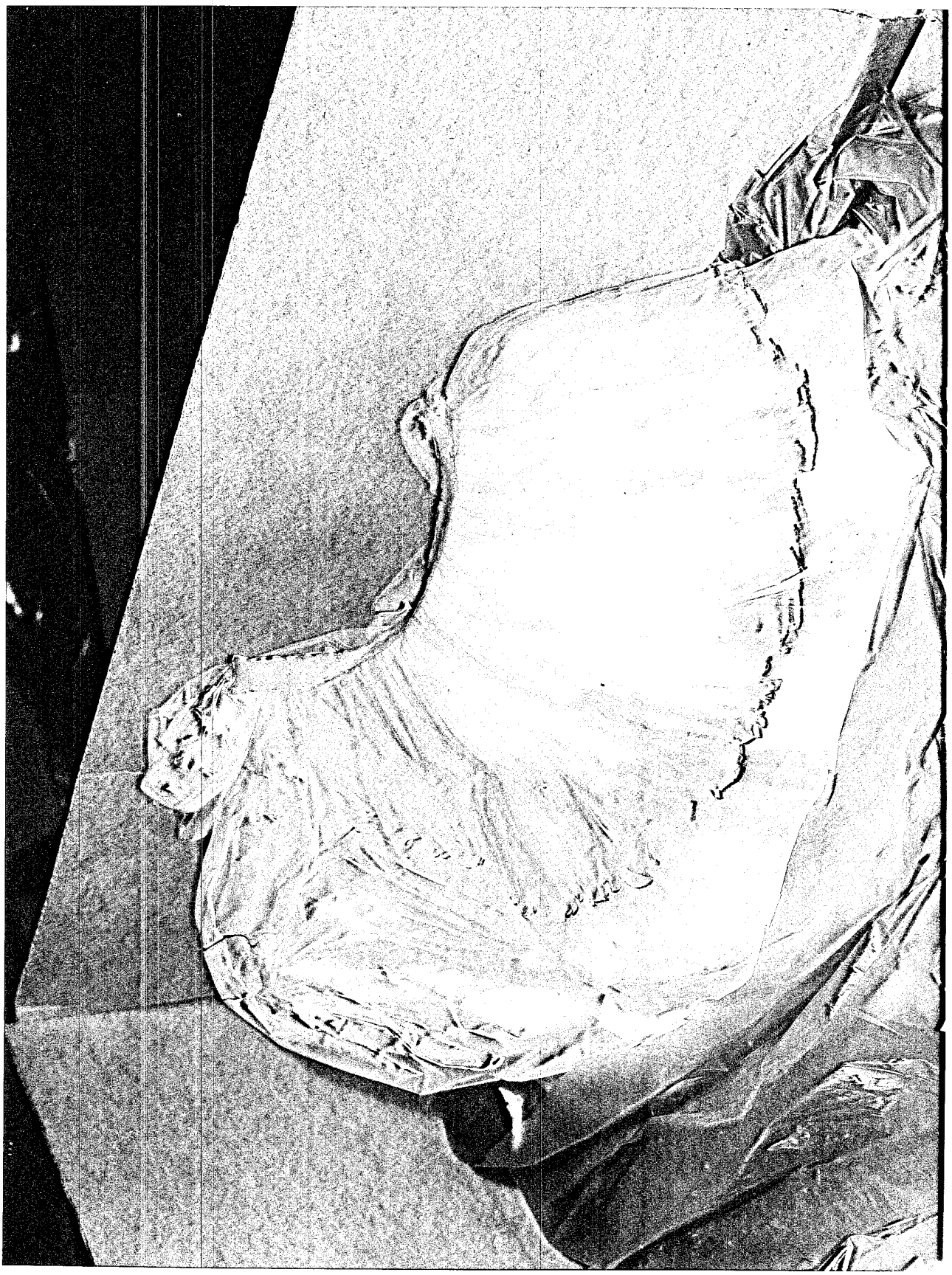


Figure 11. Pleated End of Balloon Showing Fused Polyethylene Material

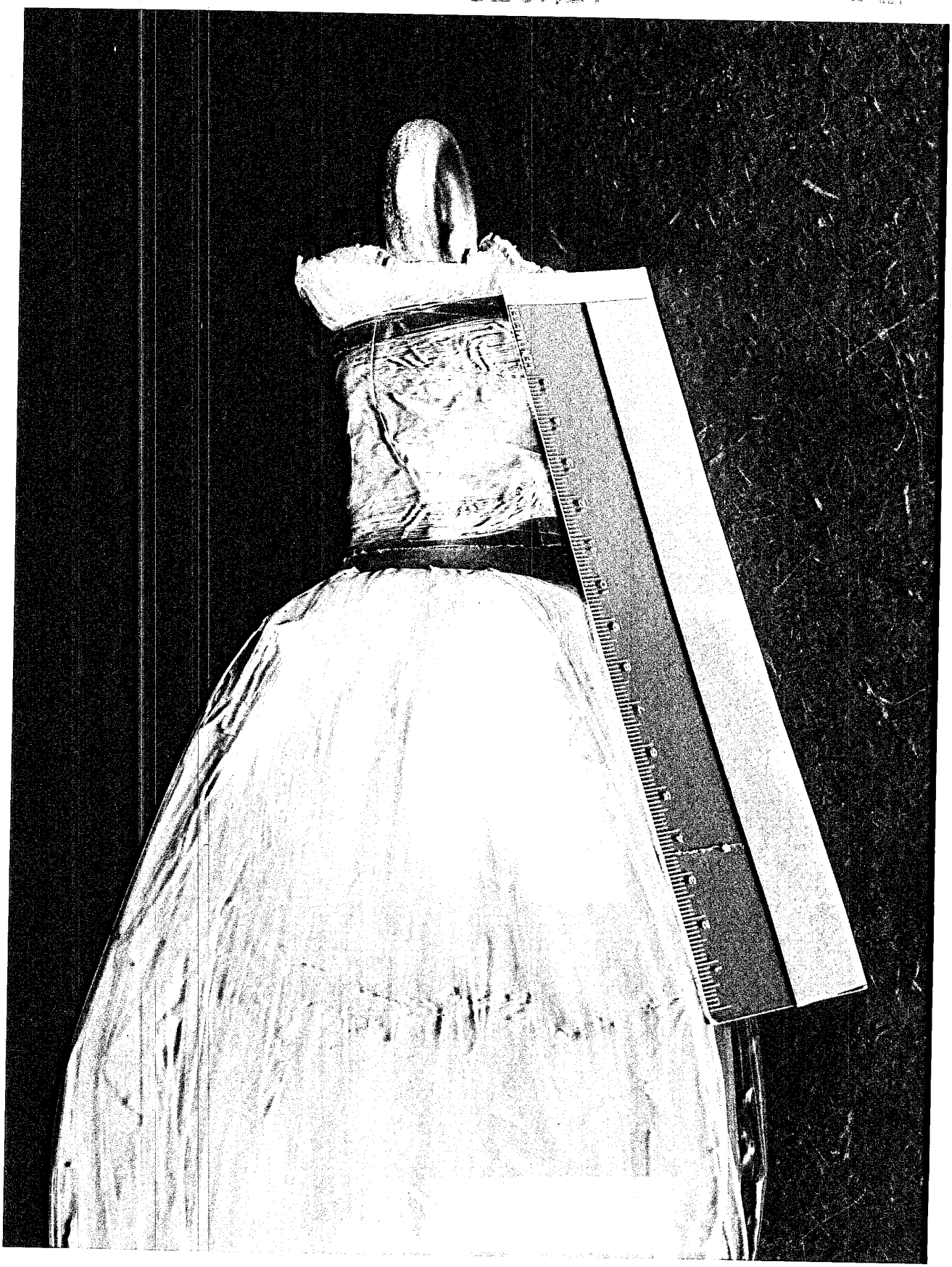


Figure 12. Completed Balloon Top Fitting

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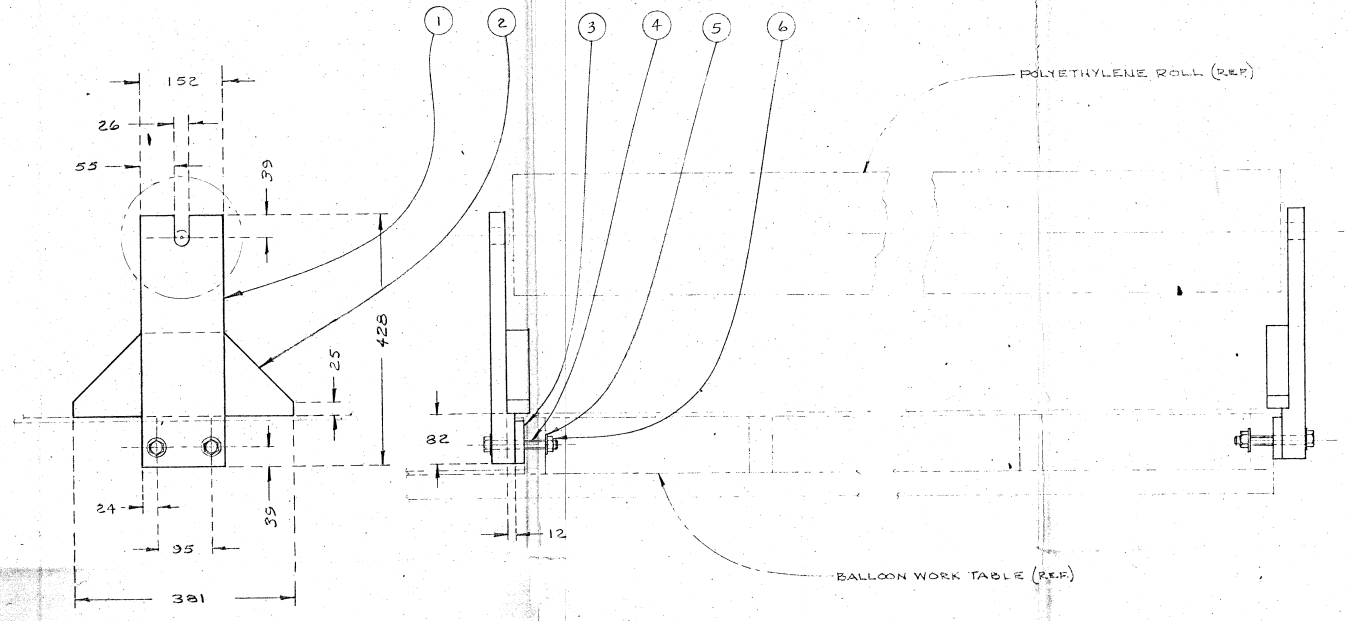

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ITEM	QUAN	DESCRIPTION	MATERIAL
6	AS REQ'D	NUT 15 M.M. THREAD	
5	AS REQ'D	PLAIN WASHER FOR 15 M.M. THREAD	
4	AS REQ'D	BOLT 15 M.M. DIA. X 25 LONG	
3	AS REQ'D	19 X 71 X 152 LONG	PINE
2	AS REQ'D	25 X 152 X 381 LONG	PINE
1	AS REQ'D	25 X 152 X 431 LONG	PINE

DISPENSER YOKES

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN M.M. TOLERANCES

231031

SCALE: 1-5

SHEET 1 OF 1

PROCUREMENT FLYER

The following confidential information is provided to assist in procuring materials for the product and the production facility.

TAPES (pressure sensitive)

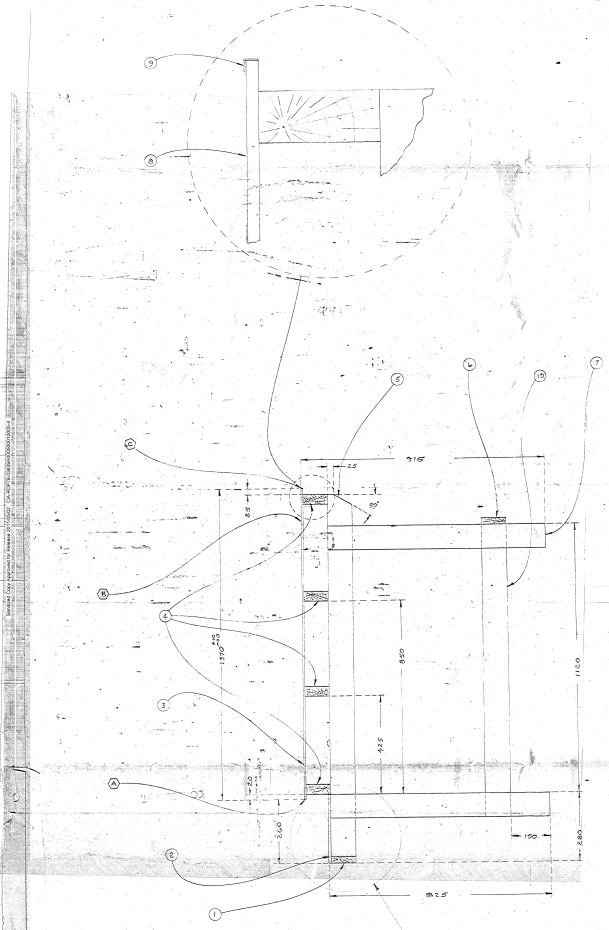
Minnesota Mining & Mfg. Co., GmbH
P. O. Box 12131
Düsseldorf, Germany

BAND SEALER

American Packaging Supply Co. (AMPAC)
Forschach, Switzerland
Att'n: Mr. A. F. Hungerbuhler

American Packaging Supply Co. is the agent for Doughboy Industries, Machine Division, New Richmond, Wisconsin. Model BD (115 volts ac, 500 watts) was used to make samples included in this report.

NOTE: EDGE (A) SHOULD BE SANDED TO BE IN STRAIGHT ALIGNMENT OVER ENTIRE LENGTH OF TABLE (FREE OF BUMPS OR ROUGH SPOTS) TABLE TOP (B) AND EDGE (C) SHOULD BE SANDED SMOOTH



THIS SHELF IS DESIGNED AS A CONVENIENT MEANS TO OPERATE THE SEALING EQUIPMENT ON.

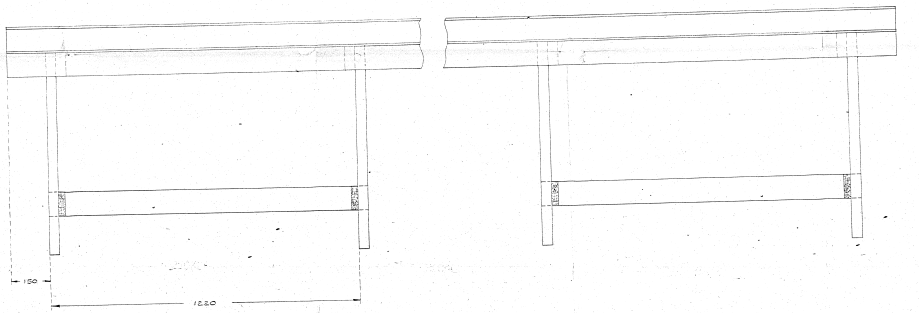
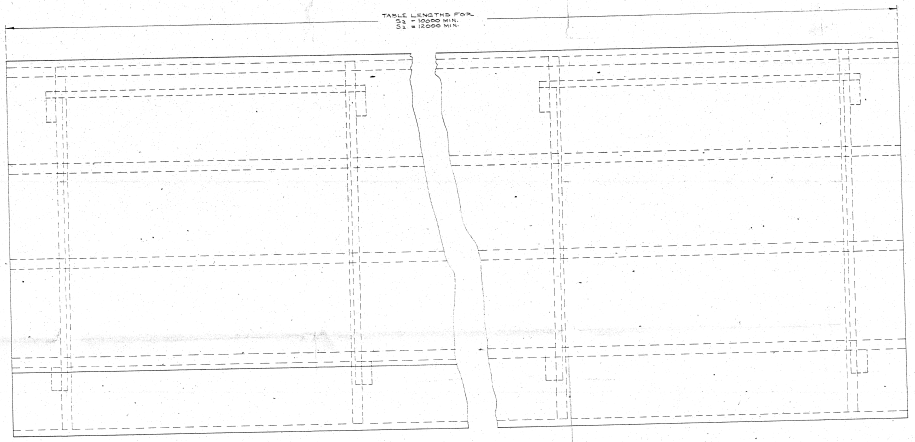


TABLE LENGTHS FOR
S1 = 10000 MIN.
S2 = 12000 MIN.



NOV 19 1957

ITEM	QUAN	PART NO.	DESCRIPTION	MATERIAL
10	XX		304 SST FEED LINE	PIPE
9	XXX		304 SST RETURN TO TANK	
8	XXX		CONVENIENCE ADDING HOPE	
7	XXX		1/2" POLYETHYLENE DRAINAGE	PLAS
6	XXX		304 SST RISE LINE	PIPE
5	XXX		304 SST FEED LINE	PIPE
4	XXX		304 SST FEED LINE	PIPE
3	XXX		304 SST FEED LINE	PIPE
2	XXX		1/2" HOSE TO NOZZLE ASSEMBLY	PIPE
1	XXX		304 SST NOZZLE ASSEMBLY	PIPE

BILL OF MATERIAL

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DECIMALS ± ANGLES ±

NAME: BALLOON WORK TABLE

NO. 231032

SCALE: 1/2

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ORIGINALS

DECLASSIFIED

EXTRANEOUS

REASON

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